

PATENT ABSTRACTS OF JAPAN

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(54) PLASTIC DISCRIMINATING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To rapidly and accurately discriminate many kinds of plastic inclusive of the grades of them.

SOLUTION: The grade related to the kind, rigidity, impact absorbability or the like of a plastic constituting a plastic sample is discriminated on the basis of the data obtained by analyzing the spectrum within an infrared region (wavelength range; 2.5-25 μm) of the transmitted or reflected light from the plastic sample. By this constitution, a variety of plastic incapable of being discriminated heretofore by a conventional plastic discriminating method utilizing infrared rays can be discriminated.

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CLAIMS

[Claim(s)]

[Claim 1] The plastics distinguishing method characterized by distinguishing the class of plastics which constitutes said plastics sample based on the information which analyzes the spectrum in the inside infrared region of the transmitted light from a plastics sample, or the reflected light, and is acquired.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the plastics distinguishing method especially applicable to judgment of the waste plastic for recycle about the approach of distinguishing the class of plastics etc.

[0002]

[Description of the Prior Art] Development of the recycling technology of a waste plastic is a technical problem very important for solution of the social concern of the increment in trash, and an exhaustion of a resource. How to carry out reuse as a raw material as the recycle approach of a waste plastic (material recycle), How to return to the monomer which is the original manufacture raw material by the pyrolysis or hydrolysis, and reuse (chemical recycle), Although the approach (fuel recycling) of reproducing as a fuel by oil-izing or gasification, the method (thermal recycling) of using the heat energy generated by combustion, etc. are learned Also in which approach, it is important for generation of a high quality recycled article, or an efficient energy recovery to perform recycle processing, after classifying a waste plastic appropriately according to a class etc. Moreover, in utilization of a recycle system, to classify quickly [as for solving a general technical problem called reduction of cost, it is inadequate just to only classify correctly in judgment of a waste plastic, since it is indispensable, and], and correctly is demanded.

[0003] Although there are the human approach and the mechanical approach as judgment approach of plastics, the problem that health is injured or there is a possibility that it may be injured also has an operator besides the problem that it cannot classify without the quality-of-the-material display with bad effectiveness in the former approach. Many of mechanical approaches are the physical separation method of classifying using the difference paying attention to the specific gravity in the inside of a fluid, electrical strength, floating, melting nature, solubility, or the specific attribute of plastics called the reinforcement to an impact. However, in such physical separation method, it is difficult to classify the plastics of varieties quickly and correctly.

[0004] On the other hand, the information about the class of plastics is extracted by the spectroscopy-technique in which an X-ray and infrared radiation were used, and the method of classifying plastics based on the information is also proposed conventionally. Among these, although the part is used for judgment of the plastics containing chlorine atoms, such as vinyl chloride, since the approach of using an X-ray has problems, like equipment becomes expensive, it has seldom spread. On the other hand, research and development are furthered as a promising approach by which the method of using infrared radiation was more suitable for utilization.

[0005] The approach of distinguishing plastics based on the information acquired as an example using infrared radiation of the plastics distinguishing method by reflectance spectrum measurement of the sample in a near infrared region (the wavelength range of 1-2.5 micrometers) is learned (for example, analytical chemistry, 1999 [48, 483,]). According to this approach, distinction quick about the great portion of plastics used for container packages is enabled.

[0006]

[Problem(s) to be Solved by the Invention] However, there are the following problems in the above-mentioned conventional plastics distinguishing method.

[0007] (1) In the plastics defined by JIS, it is actually widely used on industry and those with 90 or more kinds, among these 50 or more kinds of things which finally serve as a waste plastic exist. Therefore, for effective recycle of plastics, it is required that at least 50 or more kinds of plastics should be distinguished quickly and correctly. However, by the above-mentioned conventional distinguishing method, it is used for container packages -- if it is plastics of extent some kinds, although this can be distinguished, the above various plastics cannot be distinguished correctly.

[0008] (2) Although a mechanical strength, a consistency, impact absorptivity, etc. are plastics of the same kind by adding or mixing the matter for raising the specific quality of plastics, generally making two or more plastics with which grade (class -- the height of quality is shown --) differs is performed. It not only distinguishes a class, but in recycle of such plastics, distinction of grade is needed. However, distinction of such quality cannot be performed by the above-mentioned conventional distinguishing method.

[0009] (3) Let distinction of the waste plastic generated from large-sized trash, such as home electronics and an automobile, be an important technical problem in recycle of a waste plastic today. Although black resin, such as polypropylene, is used for large-sized trash in many cases, since black resin absorbs the great portion of infrared light, it is impossible to measure an infrared spectrum with a reflection method. For this reason, the conventional distinguishing method for using the infrared spectrum obtained by the reflection method is inapplicable to distinction of black resin.

[0010] The place which accomplishes this invention in order to solve such a technical problem, and is made into the purpose is to offer the plastics distinguishing method which can distinguish the plastics of varieties quickly and correctly also including the grade.

[0011]

[Means for Solving the Problem] The plastics distinguishing method concerning this invention accomplished in order to solve the above-mentioned technical problem is characterized by distinguishing the class of plastics which constitutes said plastics sample based on the information which analyzes the spectrum in the inside infrared region of the transmitted light from a plastics sample, or the reflected light, and is acquired.

[0012]

[Embodiment of the Invention] The plastics distinguishing method concerning this invention will distinguish the grade of said plastics based on it, if the existence of the matter added or mixed by this plastics is judged and such matter exists, while distinguishing the class of plastics which constitutes this plastics sample by analyzing the spectrum (wavelength intensity distribution) in the inside infrared region (the wavelength range of 2.5-25 micrometers) of the transmitted light from a plastics sample, or the reflected light. Technique, such as pattern matching used for usual in the field of

spectroscopy and multivariate analysis (for example, principal component analysis), is used for the analysis of a spectrum.

[0013] In the plastics distinguishing method concerning this invention, using the spectrum in not a near infrared region but an inside infrared region is based on the following reasons. That is, in order to distinguish correctly not only the class of plastics but its grade, so much information is needed. If the spectrum in a near infrared region is compared with the spectrum in an inside infrared region, latter one includes more information. Although sufficient information was acquired even from the spectrum of a near infrared region when only distinguishing some kinds of limited plastics like before, this invention is a new technique aiming at distinguishing to the grade of the plastics which was not made applicable to distinction conventionally, and it became clear for such distinction that the information acquired from the spectrum of a near infrared region is inadequate by this invention person's etc. research. So, in this invention, while including more information, the spectrum in an infrared region was used.

[0014] As mentioned above, since the spectrum of an inside infrared region includes much information, if the information is analyzed appropriately, it not only can distinguish the class of plastics, but distinction of the grade of plastics will be attained. However, the wavelength field (or wave number field) where the difference of the grade of plastics appears on a spectrum most notably changes with classes of plastics. For example, in the case of the polypropylene resin used for the bumper of an automobile, if the difference of the spectrum configuration by the difference in grade is said in a wave number field, it will appear most notably in the field of 3000cm^{-1} . Then, in the plastics distinguishing method concerning this invention, it is desirable that distinguish the class of plastics first, and the difference of the grade of the kind of plastics determines the wavelength field (or wave number field) which appears most notably, and distinguishes the grade of the plastics based on the analysis result of the spectrum in the wavelength field (or wave number field). In addition, what is necessary is just to investigate beforehand the wavelength field (or wave number field) where the difference of grade appears most notably in the experiment for every plastics.

[0015] As stated previously, the inside infrared region of the absorption coefficient of the infrared radiation by the sample is higher than a near infrared region. therefore, the method of distinguishing the plastics concerning this invention -- setting -- the configuration of a sample (plastics sample), and a front face -- while choosing a measuring method with which the spectrum of sufficient reinforcement is obtained also in an inside infrared region in consideration of description, a color, permeability, etc., it is desirable to pretreat a sample if needed.

[0016] For example, it is possible to measure a reflectance spectrum by the specular reflection method or the total reflection method (ATR method) for example, without performing special pretreatment, when making applicable to distinction the sample which has a smooth front face. However, since infrared radiation will almost be

absorbed when the sample consists of black resin as stated previously, a specular reflection method cannot be used. Then, when especially a sample consists of black resin, it is desirable to perform spectrum measurement by the total reflection method. When making applicable to distinction the sample which does not have the smooth front face on the other hand, it is not desirable to perform spectrum measurement by the specular reflection method. Moreover, although troublesome pretreatment of making a sample into a thin film integrated circuit with a thickness of 0.05mm or less, or cutting down such a flake is needed when it is going to use a transmission method, this is not desirable for speeding up of processing. So, when making applicable to distinction the sample which does not have the smooth front face, it is desirable to perform spectrum measurement with a total reflection method or a diffused reflection method. Here, any shall be used between a total reflection method and a diffused reflection method chooses according to the shape of front planarity of a sample. For example, when a powdered sample can be obtained by easy processing from a sample front face, a diffused reflection method may be used.

[0017] In addition, a total reflection method has the especially wide application range regardless of the shape of the configuration of a sample, and front planarity, a color, and permeability in the describing [above] all directions method. Moreover, by the total reflection method, a spectrum even with the short measuring time high [an SN ratio] for about several seconds is obtained. For this reason, in the method of distinguishing the plastics concerning this invention, it is good to make a total reflection method into the usual measuring method, and to use other measuring methods together suitably according to the shape of the configuration of a sample, and front planarity, a color, and permeability.

[0018]

[Effect of the Invention] As mentioned above, according to the plastics distinguishing method concerning this invention, distinction of the various plastics which was not able to be distinguished is attained by the conventional plastics distinguishing method for having used infrared radiation.

[0019]

[Example] The trial which distinguishes the polypropylene resin (it is hereafter called PP bumper material) used for the bumper of an automobile by the plastics distinguishing method concerning this invention was performed. The following four kinds were used as a sample.

- (1) NY-10 (a super-high rigidity PP bumper material, the Japan Polychem make, black)
- (2) NM-20 (a super-high rigidity PP bumper material, grand polymer company make, white)
- (3) NS-30 (a super-high rigidity PP bumper material, the Sumitomo Chemical Co., Ltd. make, white)
- (4) TX1170A (a high rigidity PP bumper material, the Japan Polychem make, black)

[0020] The spectrum Measuring condition in the above-mentioned trial is as follows.
measuring method: -- micro ATR method spectroscopy: -- Shimadzu Fourier transform infrared spectrophotometer FTIR-8300 resolution: -- 8cm⁻¹ detector: -- MCT mold semiconductor detector product **: -- 100 times (about 2 minutes)

[0021] The spectrum of each sample obtained by the above-mentioned trial is shown in drawing 1 - drawing 4 . In drawing 1 , the spectrum of NM-20 and drawing 3 show the spectrum of NS-30, and, as for the spectrum of NY-10, and drawing 2 , drawing 4 shows the spectrum of TX1170A. In addition, in each above-mentioned drawing, an upper case shows the spectrum of the measured whole wave number field, and the lower berth shows the place which expanded the part of wave number field 3000-2750cm⁻¹ of this spectrum.

[0022] When the spectrum of the whole measurement field of the four above-mentioned sorts of samples was compared, in wave number field 3000-2800cm⁻¹, it turned out that the peak group in which it has sufficient height and a difference of the configuration by the sample is accepted exists. Then, as shown in the lower berth of each drawing, when the part of wave number field 3000-2800cm⁻¹ of a spectrum was expanded and it compared in more detail, in the peak which appears in the wave number [of 2850cm⁻¹]-1 neighborhood especially, it turned out that a difference of the configuration by the sample is accepted most notably. In addition, the difference of such a configuration was similarly accepted by black resin (NY-10, TX1170A) or white resin (NM-20, NS-30).

[0023] From the above-mentioned result, PP bumper material is considered that it is possible to distinguish the difference and the rigid difference in the manufacturer by analyzing the configuration of a peak of appearing in the wave number [of 2850cm⁻¹]-1 neighborhood more preferably by analyzing the part of wave number field 3000-2800cm⁻¹ of a spectrum.

[0024] In addition, when distinguishing another plastics material, it cannot be overemphasized that the value of a desirable wave number field and/or the wave number becomes a thing different generally from the above.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The spectrum Fig. of first PP bumper material (NY-10).

[Drawing 2] The spectrum Fig. of second PP bumper material (NM-20).

[Drawing 3] The spectrum Fig. of third PP bumper material (NS-30).

[Drawing 4] The spectrum Fig. of fourth PP bumper material (TX1170A).